BADER (C.)

The human eye in health &c

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THE
HUMAN EYE IN HEALTH AND DISEASE

AS SEEN WITH THE OPHTHALMOSCOPE.

(SECOND SERIES.)

By C. BADER.

In the 'Guy's Hospital Reports' for the year 1865 were published three chromolithographs, representing the appearance of the optic disc of the emmetropic, the hypermetropic, and the myopic eye, when examined with the ophthalmoscope by the direct method. It was there shown that the shape, and with it the refraction, of an eye may be recognised by peculiarities in the appearance of the optic disc.

The six chromolithographs published in the present volume exhibit the appearances of the optic discs of differently coloured eyes in health.

Modes of examining the Optic Disc with the Ophthalmoscope.

I. *Examination of "the inverted image," or indirect ophthalmoscopic examination of the optic disc.*

Suppose we wish to examine the optic disc of a healthy right eye with blue iris, the pupil having been dilated by atropia, and the observer, the patient, and the light, being placed as is usual in ophthalmoscopic examinations:—

We take the ophthalmoscope in the right hand, grasping its margin with the thumb and forefinger, and turn the reflecting surface towards the patient. We "throw" the light upon the

patient's right eye, and approach the eye with the ophthalmoscope until the circular surface of light on the patient's face has nearly the size of the ophthalmoscope itself. We must take care to keep the circular surface of light continually on the patient's eye while raising the ophthalmoscope to our own right eye. When looking through the sight hole, we perceive the patient's pupil to appear brilliant red instead of black. If the pupil appears black, we either are not throwing the light upon the pupil, or are not looking through the sight hole of the ophthalmoscope.

When we have obtained the red reflection from the pupil, we next look for the optic disc, which is most quickly found (the ophthalmoscope being held by the thumb and fore-finger) by holding up the little finger of the same hand, and directing the patient to look at the tip of it. The centre of the yellow spot of the patient's right eye is thus directed to the tip of that finger, and the optic disc comes to stand opposite the pupil.

A change in the colour of the reflection from the pupil, from red to whitish-red or brilliant white, indicates that the optic disc is in view. The observer should persist in his endeavours until he has obtained the brilliant whitish reflection.

In persons with dark irides, the difference in the reflection from the pupil is still more striking, on account of the contrast of colour between the optic disc and the tunics.

Having thus obtained the reflection peculiar to the optic disc, we place the convex lens (holding it between the fore finger and thumb of the left hand) before the eye under examination. The diffused image of the flame, which is "thrown into the eye" by the ophthalmoscope, serves to illuminate those parts of the interior of the eye which lie within the area of that image. The rays of light which are reflected, *e.g.* from the optic disc thus illuminated, have to pass through the lens held in front of the patient's eye, and an inverted defined image of the optic disc, &c., is formed in front of the lens, *i.e.* between it and the observer, and is viewed by him.

In this case we do not directly examine the optic disc, but only its inverted aërial image; hence we term this method "the examination of the inverted image" or "the indirect ophthalmoscopic examination."

The little finger of the hand which holds the lens is placed

on the patient's cheek to steady the lens, while the middle or ring finger is kept disengaged, to be placed, if necessary, upon the margin of the upper lid so as to raise it, or gently to press upon the eyeball, to produce and watch the pulsation of the retinal arteries in the optic disc. The lens itself is held at from one to two inches from, and somewhat obliquely in front of, the patient's eye. If the lens be held vertically the images of the ophthalmoscope, which appear upon the two surfaces of the lens at its centre, interfere with the view of the part beyond. Hence, the lens should be held obliquely so as to cause the two images to recede from each other. By approaching the lens to, or removing it from, the eye under examination, we soon succeed in obtaining a distinct view of the well-defined (aërial) image of the optic disc, &c.

This image can be enlarged by our placing behind the sight hole of the ophthalmoscope a convex lens of greater focal distance (one of from ten to twenty inches focal distance).

II. *Direct ophthalmoscopic examination of the optic disc.*

Another mode of examining the optic disc with the ophthalmoscope is the direct method, or the examination of the erect image of the optic disc.

Though by the indirect method we can at one glance overlook the entire optic disc, we do not obtain such a correct idea of its colour, outline, &c., nor of its relation to adjoining parts; neither do we see it so highly magnified as by the direct method. This method should, therefore, always be adopted when we wish to see the finer details of the interior of the eye. It is accompanied by the inconvenience of having to approach the eye to within one or two inches, but a few seconds suffice to obtain a view of the optic disc, &c., which no other method of ophthalmoscopic examination gives with equal facility.

The optic disc of the emmetropic and of the hypermetropic eye may be examined with the ophthalmoscope alone: to see that of the highly myopic eye with equal distinctness a suitable concave lens has to be placed behind the sight hole of the ophthalmoscope.

Though the direct method may be adopted without dilating

the pupil of the eye under examination by atropia, it is better to employ this agent.

The direct method has been described at length in the vol. of the 'Guy's Hospital Reports' for 1865.

It remains to state to which individual parts of the optic disc, and of the tunics immediately adjoining it, our attention should more especially be given.

In figs. 4, 5, 6, the optic disc is represented as it appears when examined by the indirect method. When examined by the direct method it appears much larger; the cornea and crystalline lens then act as a strong magnifying lens; and the optic disc (the real diameter of which, in health, is about $\frac{1}{11}$ of an inch) consequently appears so much enlarged that, though the pupil be dilated to its utmost, we cannot overlook the entire disc at once; to do so we have to look in different directions through the pupil. Having obtained a clear view of the optic disc, we must pay attention to its surface, size, shape, margin, colour, blood-vessels, and then to the tunics (the sclero-choroido-retinal aperture) adjoining it.

The optic nerve and the optic disc.

A fibrous sheath surrounds the optic nerve in the orbit: it is by some termed the outer sheath of the nerve, and consists of fibrous, mixed with elastic, tissue. This sheath, on reaching the sclerotic, becomes firmly attached to the latter; its fibres mix with those of the sclerotic at the sclerotic aperture, *i.e.* at the opening in the sclerotic through which the optic nerve fibres have to pass.

The sheath is separated from the optic nerve, or (properly speaking) from the fibrous tissue which immediately surrounds the nerve fibres, by loose connective tissue.

The bulk of the optic nerve itself consists of fibrous tissue and of nerve fibres. The fibrous tissue of the nerve which lies nearest the tunics is intimately connected with the retina, the choroid, and the inner margin of the sclerotic aperture.

Loose connective tissue passes between the outer sheath and the fibrous tissue which immediately surrounds the optic nerve, thus allowing of a limited movement of the nerve within the sheath.

The fibrous tissue (generally termed connective tissue) which immediately surrounds the bundles of optic nerve fibres is white and opaque outside the eyeball, semi-opaque on a level with the inner third of the sclerotic, and transparent in the choroidal and retinal apertures and in the retina.

Its fibres, examined microscopically, show a circular course at the surface of the nerve, and round the vessels which pass through its middle. The fibres at the surface (the outer circular fibres) have been termed the inner sheath of the optic nerve. Larger fasciculi of fibres separate the bundles of optic nerve fibres from each other, and single fibres intervene between the individual nerve fibres.

The optic nerve, the bulk of which consists of this fibrous or connective tissue, gradually becomes thinner, and changed in colour, as it advances through the tunics of the eye. This is owing to changes, not in the nerve fibres themselves, but in the connective tissue, which becomes less in quantity and altered in colour as it advances with the nerve fibres within the sclerotic aperture. This connective tissue, where it extends across the choroidal aperture (at the point where the sclerotic and choroidal apertures meet) is termed the fascia cribrosa.

Arrived on a level with the vascular portion of the choroidal aperture, the circular fibres of the connective tissue merge into the adjoining sclerotic and choroidal apertures. This is the point of attachment of the connective tissue of the optic nerve itself. It is at this point that the distension of the myopic eye is most conspicuous.

A network of single transparent nucleated fibres separates the optic nerve fibres from each other in the retinal aperture. The nuclei of the fibres have a regular arrangement, stand close to each other, and can be traced upon the retina.

The optic nerve fibres within the orbit and in the sclerotic aperture are united into bundles, each bundle being separated from the next by connective tissue, each carrying from six to thirty optic nerve fibres, and each nerve fibre again being separated from the adjoining ones by a filament of connective tissue. Connective tissue (its fibres having a circular arrangement) separates the bundles of nerve fibres from the retinal vessels, where these pass through the optic nerve. Similar fibres are found at the outer surface of the nerve. They join

the loose connective tissue which intervenes between the optic nerve and its sheath.

The largest bundles of nerve fibres are situated midway between the surface and the middle of the optic nerve.

The optic nerve, as it advances within the tunics of the eyeball, becomes thinner, not through diminution of the number of its nerve fibres, but, as stated above, through diminution of the surrounding connective tissue. The nerve appears thinnest in the choroidal aperture.

At the upper margin of the retinal aperture the optic nerve fibres bend away (diverge) from the axis of the nerve, and pass on to the inner surface of the retina, where they are described as the layer of optic nerve fibres. This layer is thickest over the retinal aperture.

The portion of the optic nerve which can be seen with the ophthalmoscope within the eye is termed *the optic disc.*

The *margin* of the optic disc is the portion which joins the tissues of the eyeball.

The *centre* of the optic disc is the point where the larger number of the blood-vessels of the retina meet.

The size of the optic disc varies according to age. It appears smaller in children, larger in full grown persons, and becomes smaller again in advanced life. As has already been stated, its diameter at the choroidal aperture is about one eleventh of an inch.

The shape of the optic disc as regards outline ("its margin") varies considerably in healthy eyes. In the majority it is nearly circular. In some it appears vertically oval. (See Plates.)

Its margin may *appear* altered through anomalies of the refracting media, or through morbid changes in the tunics at the choroidal and sclerotic apertures. It may be *really* altered through disease of the nerve itself. The margin appears best defined in dark eyes.

A white crescentic figure is often seen skirting part of the margin of the disc, more often that nearest the yellow spot. (See Plates, figs. 3 and 6.) This figure is generally present in both eyes of the same person; it is due to the pigment and blood of the choroid not advancing up to the nerve, thus leaving the white inner surface of the sclerotic exposed. The

contrast in colour between the crescentic figure and the optic disc is well marked in hyperæmia of the optic disc, while in anæmia or atrophy of the optic disc we may have difficulty in recognising the boundary between the disc and the sclerotic.

2. A fringe of pigment (a black crescent) may be found in otherwise healthy eyes at any part of the disc. This is caused by accumulation of pigment in the margin of the choroidal aperture.

Curvature of the surface of the optic disc. In health a slight indentation exists at or near the centre of the optic disc at the spot where the nerve fibres bend away from the fibrous tissue which surrounds the blood-vessels. The surface of the disc, where it is occupied by nerve-fibres, is convex towards the vitreous chamber.

The *colour* of the optic disc.—To see its natural colour the optic disc should be examined with the ophthalmoscope by the direct method. Great varieties of colour are compatible with normal vision.

It generally appears of a brilliant transparent pale pink colour, except the part which joins the retinal vessels where they occupy the middle of the disc. This portion generally appears grey-white or brilliant white (see Plates), and may occupy as much as one fifth of the nerve surface. As a rule it is observed in both optic discs of the same person, but varies in extent.

Examined by the indirect method, the optic disc, especially in "fair" eyes, appears deep pink or red. A white or bluish-white optic disc has repeatedly been seen in young persons with quite normal vision.

The optic disc consists of transparent, semi-opaque, and opaque portions. The opaque portion, which is level with the sclerotic aperture, together with the blood circulating among the optic nerve-fibres, determines the apparent colour of the disc. The nerve-fibres are transparent throughout, and the filaments of connective tissue separating the fibres from each other and from the blood-vessels are transparent in the retinal and choroidal apertures. If we describe an optic nerve or an optic disc as anæmic or hyperæmic, &c., we in reality describe the colour of the opaque fibrous tissue in the sclerotic aperture, and the quantity of blood circulating in the optic disc.

The optic disc appears finely dotted with grey, minute spots when examined by the direct method and slightly magnified. These spots are the larger bundles of transparent nerve-fibres emerging from the opaque surrounding connective tissue. The bundles of nerve-fibres, where they radiate from the optic disc over the retina, may in dark eyes be visible as faint greyish lines.

Vestiges of the arteria centralis are occasionally found at this spot. The larger this white portion of the healthy optic disc the wider we suppose the cupped portion of its surface to be. Whether the edges of the cup are abrupt or not depends upon the bend of the optic nerve-fibres. The vessels in this kind of cup appear natural as regards number, size, and course. The optic nerve-fibres are confined to the pink portion of the optic disc.

The contrast in colour between the optic disc and the adjoining tunics is greater, the more pigmented the choroid.

Blood-vessels of the optic disc and of the retina.

The ophthalmic artery passes through the optic foramen to the outer and lower side of the optic nerve; within the orbit, and at a short distance from the optic foramen, it crosses over the surface of the nerve. There it sends off the retinal artery, or arteria centralis retinæ; the latter passes into the optic nerve, about three eighths of an inch from the sclerotic, and runs among its fibres to the retina.

The veins of the retina emerge from the optic nerve in the orbit at from one eighth of an inch to three eighths of an inch from the sclerotic; they, and most of those of the choroid and of the orbit, empty themselves into the ophthalmic vein, which passes through the sphenoidal fissure, and joins the cavernous sinus.

The optic disc receives its blood supply from the short posterior ciliary arteries and from the retinal artery.

Very small arteries pierce the sclerotic close to the optic disc. In the sclerotic round the optic disc these arteries form a plexus, which sends branches into the choroid and among the

nerve fibres. These minute arteries form loops round some of the bundles of nerve fibres and anastomose with arteries of the optic disc and of the retina. This is the only spot where the vessels of the retina and of the optic disc anastomose with vessels of the other tunics. The anastomoses are chiefly arterial, and only a few small veins can be traced from the choroid into the optic disc.

The blood-vessels of the retina enter and leave the eye by passing through the optic disc. Within the retina they do not anastomose with those of the other tunics. All the blood which goes to and comes from the retina has to pass through the optic disc. The walls of the vessels appear transparent. Several of the arteries subdivide in the optic disc before reaching the retinal aperture. (See Plates). Thus from near the middle of the optic disc two large branches pass upwards, and two downwards, into the retina across the optic nerve fibres. In the retina, close to the optic disc, they subdivide into smaller branches, a large number of which turn towards the region of the yellow spot. The arteries break up into capillaries. Besides the larger trunks there are many small vessels which enter and leave the retina on the right and left of the retinal aperture.

In young persons three or four arteries, and as many veins, can sometimes be seen passing through the optic disc. In middle-aged persons generally only one or two large arteries can be observed. The apparent number decreases as age advances. The greater number of vessels are observed in the outer or temporal part of the retina. Peculiar twistings of the arteries are often seen, especially in the optic disc.

The veins which return from the retina also pass through the optic disc ; they run near the arteries.

The arteries can be distinguished by their bright red colour and straight course. They are thinner, and not unfrequently present a double contour, *i.e.* the blood seems to glide along the sides, while the central parts of the vessels appear empty. This is due to light being reflected from this part of the vessels.

The veins are darker, more numerous, larger, and more variable in diameter. They are readily distinguished from the arteries by pressing gently upon the eyeball with the finger, while

examining with the ophthalmoscope; the pulsation of the arteries in the optic disc then becomes at once apparent.

Pulsation of the retinal blood-vessels.—The relations between the vitreous substance and the blood circulating in the retina are such, that the slightest pressure upon the blood-vessels becomes apparent, especially in the optic disc. It causes, if at all considerable, visible pulsation of the arteries, and a peculiar undulation of blood in the veins, which latter is also termed a pulsation. Large, flat veins, tapering off as they leave the optic disc, show this undulation of blood best. It consists in an irregular filling of some and emptying of other parts of the veins. The contraction of the vein advances from the centre towards the margin of the optic disc, while the dilatation commences at the margin. A short pause intervenes between the maximum of dilatation and the commencement of contraction. All movements of the eye, all efforts at accommodation for near objects, and many changes in the respiration, cause increase of the venous pulse.

The blood, thrown into the retinal arteries with every systole, has to pass through the capillaries to reach the veins. The arteries momentarily become dilated, and the quantity of blood in the eye is increased. The vitreous substance during this movement is pressed upon, and, in its turn, presses upon the optic disc and its blood-vessels.

This pressure becomes perceptible in the veins in the optic disc. The veins become flattened out, before the quantity of arterial blood, which causes the increased pressure, has reached them. The current of blood in the veins is lessened until the pressure of the arterial blood (during the systole) has reached them through the capillaries. The systole having passed, the pressure of the vitreous substance becomes lessened, the veins become still more dilated, and the blood readily escapes from the eye. The circulation in the capillaries is never interrupted.

The pulsation of the retinal arteries in the optic disc is not visible under ordinary circumstances. In rare instances it occurs spontaneously, and then appears to be due to a peculiar arrangement of the vessels. Artificial pressure upon the eyeball, or a morbidly increased tension, is required to render it visible. A brisk filling and emptying of the arteries in the

optic disc, synchronous with the pulse, is observed when gentle pressure is made upon the eyeball. The retinal arteries are thus pressed upon the margins of the sclerotic and choroidal apertures, beyond which apertures the visible pulsation does not extend. An entire displacement of the blood from the arteries, with cessation of the pulse, occurs when the pressure is greatly increased.

The sclerotic aperture.—The colour of the inner (choroidal) surface of the sclerotic can be readily seen with the ophthalmoscope in persons with blue irides ; while, if the choroid is highly pigmented, too little light reaches the sclerotic to render it conspicuous.

If the sclerotic is very thin some light passes through it and large blood-vessels may be perceived in its substance.

The brilliant white inner surface of the sclerotic is most conspicuously seen with the ophthalmoscope when the choroid is highly atrophic. The blood-vessels of a highly atrophic choroid are empty, the pigment has disappeared, and the white sclerotic is viewed through the transparent retina and choroid. The brilliant white spots so often seen with the ophthalmoscope (especially near the optic disc and in the region of the yellow spot) are mostly due to this. The same applies to the white crescentic figure which is so frequently observed adjoining the outer margin of the optic disc.

For the relations of the sclerotic aperture to the sheath of the optic nerve and to the nerve (and optic disc) itself see above.

The choroidal aperture.—The choroid, when examined with the ophthalmoscope in the healthy living eye, presents many peculiarities.

It differs in appearance as regards colour in "dark" and in "fair" persons. (See Plates.) From the colour of the iris we can foretell that of the choroid. The contrast between the brilliant red colour of the choroid in the eye with blue iris, and the almost neutral tint of the one with black iris, is very striking. The colour of the choroid is one of the most prominent features of the living eye. The brilliancy and intensity of the generally red colour depend upon the quantity

and degree of tinting of the pigment of the choroid, and upon the blood circulating in the vessels of that tunic. The greater the quantity of light which is reflected from the white inner surface of the sclerotic, and which returns through the choroid, retina, &c., to the observer's eye, the better can the details of the choroid be recognised. The sclerotic is to the choroid what the silvering is to the glass of a mirror.

The more pigment there is in the choroid the less light passes through it (or is reflected from the sclerotic), and the less can the details of the interior of the eye be recognised with the ophthalmoscope. Any opaque substances (clots of blood, &c.) intervening between the choroid and the sclerotic prevent our seeing that part of the sclerotic and choroid.

To be able to examine the choroid thoroughly the pupil should be well dilated. The whole of the choroid, from the optic disc to near the ora serrata, and in albinos even the tips of the ciliary processes can be seen with the ophthalmoscope. Particular attention should be be paid : (1) To "the choroidal aperture," *i.e.* to the choroid where it surrounds the optic disc ; (2) to the region of the yellow spot, which is readily seen by directing the patient to look at the sight-hole of the ophthalmoscope ; (3) to the equatorial region, which becomes visible on looking slantingly into the eye. The details of the structure of the choroid which can be recognised by direct ophthalmoscopic examination are, groups of hexagonal cells, groups of stellate pigment cells (see Plates, fig. 3), the veins (venæ vorticosæ), and the ciliary arteries.

The hexagonal cells (*i.e.* their pigment granules) appear more translucent when the light traverses them obliquely, and more so in some eyes, or in some parts of the same eye. The granules of many cells have a deeper brownish tint. Groups of such cells, when standing side by side with cells containing less tinted granules, cause the inner surface of the choroid to appear sprinkled with groups of minute brown spots. The recognition of the situation of the hexagonal cells is an important means of localising morbid changes in other parts of the choroid and retina. Morbid changes occurring in these tunics hardly ever fail to be accompanied by alterations in the hexagonal cells.

The groups of stellate pigment cells, which occupy the spaces

between the veins of the choroid, appear as small defined patches, varying in colour from light to dark brown. (See Plates, fig. 3.) Very abundant, strongly tinted, stellate pigment cells, when intervening between the veins and the hexagonal cells, give the choroid a more uniform neutral tint. (See Plates, fig. 2).

The choroidal aperture, *i.e.* the opening in the choroid through which the optic nerve-fibres and the retinal blood-vessels have to pass, lies between the retinal and sclerotic apertures, and, like these, surrounds the optic nerve. At that part of the aperture which is level with the elastic lamina of the choroid a thin ring of concentric elastic fibres is found.

In many otherwise healthy eyes we find the margin of the aperture more pigmented than the adjoining choroid, and thus giving rise to a black or brown crescent, or zone, round the optic disc.

The retinal aperture.—The retina is firmly attached to the margin of the optic disc by transparent connective tissue. The opening in the retina through which the optic nerve fibres have to pass is termed the retinal aperture. Anomalies of this aperture can be recognised with difficulty so long as the retina is transparent.

Among the peculiarities observed during development of the retina at the retinal aperture must be mentioned :

1. The occurrence of folds. About the ninth month of fœtal life some folds may still be found in the retina near the lower margin of the optic disc.

2. About the beginning of the third month the fœtal fissure is broadest near the optic disc. It is closed about the commencement of the fourth month.

3. About the end of the third month the retinal aperture is very small. It is not circular, but irregular, some parts of the retina projecting more towards the optic disc than others. These prominences disappear about the fifth month, when the aperture becomes more round.

The retina, when viewed with the ophthalmoscope, appears transparent, in fair persons; transparent, with a faint grey tint, in persons with brown irides; and transparent, with a bluish tint, in those with black irides.

DESCRIPTION OF PLATES.

The six figures of the two plates represent the healthy optic nerve (optic disc) and a small portion of the tunics adjoining it, in the fair, the brown, and the dark eye respectively. Figures 4, 5, 6 represent the healthy optic disc (of the eyes just mentioned) as it appears as regards size, shape, colour, &c., when viewed by the normal eye with the ophthalmoscope in the inverted image.

The diameter of the healthy optic nerve (optic disc or od.), as ascertained (with or without the microscope) in healthy eyes removed from the body, amounts to about one eleventh of an inch at the choroidal aperture. Viewed with the ophthalmoscope (a concave mirror of from 12- to 15-inch focus, and a biconvex lens of about 2½-inch focus) its inverted image appears of about the size, shape, colour, &c., represented in figs. 4, 5, 6.

The optic disc, &c., is represented inverted, *i.e.* what is shown as its upper margin is in reality its lower one; what appears to be the outer margin is the inner one, &c. The optic disc appears inverted when examined with the ophthalmoscope "by the indirect method."

The figures represent as much of the tunics (retina, choroid, and sclerotic) adjoining the optic disc, as is seen simultaneously with the optic disc. To form an idea how much this is it must be remembered that the yellow spot lies about one eighth of an inch from the nearest margin of the optic disc. Yet it can not be seen at the same time as the disc itself. This shows that we overlook but a small portion of the tunics at the same time as the optic disc.

Figures 1, 2, 3, represent on an enlarged scale the parts represented in figs. 4, 5, 6.

The optic disc occupies the middle in all the figures. The retinal arteries which diverge from it have a light red colour; the retinal veins which converge towards its centre have a darker red colour. The contrast of colour between the venous and arterial blood is not so well marked in the living eye as is represented in the figures.

The optic disc of fig. 1 is represented somewhat too red ; it may be called hyperæmic.

The blood in the retinal vessels, where they pass through the optic disc, should appear somewhat more transparent, as being subtended by a brilliant, pinkish-white substance.

In all other respects the chromolithographs are faithful copies of the originals, which are preserved in the museum of Guy's Hospital.

Fig. 1.

The optic disc, and the retina, choroid and sclerotic immediately adjoining it, of the healthy left eye of a person, aged 31, with blue irides.

The optic disc is round, and is represented in the centre of the figure. The middle of the optic disc has a white, the rest a brilliant pale red colour. The white portion surrounds the blood-vessels, where they pass through the optic disc ; it shades off into the red portion. The bundles of optic nerve-fibres occupy the red portion of the optic disc.

The blood-vessels of the retina (two large arteries and two large veins) pass into and through the optic disc. From the optic disc they diverge into the retina ; the larger number of them branch towards the left side, in the direction of the region of the yellow spot.

The brilliant red surface which surrounds the optic disc, and which extends up to the black margin of the figure, represents the choroid. The latter is subtended by the white sclerotic, and covered by the transparent retina. The light of the ophthalmoscope (reflected from the white inner surface of the sclerotic) has to pass through the transparent blood-carrying vessels of the choroid.

Fig 2.

The same parts as represented in fig. 1, but belonging to a negro, aged 54, with black irides.

The round optic disc occupies the centre of the figure. The centre of the optic disc has a brilliant white, the rest a delicate

red colour. The optic disc appears particularly well defined, owing to the contrast of colour between it and the choroid.

Two large retinal veins and three large retinal arteries pass through the optic disc into the retina. Some of the vessels subdivide in the disc, others in the retina. The bluish-violet surface which extends from the optic disc to the margin of the figure represents the choroid. Owing to the distribution of light from the ophthalmoscope it has a brighter colour near the optic disc.

The abundance of colouring matter in the pigment cells and granules of the choroid gives the latter the bluish colour. The light of the ophthalmoscope is reflected from the sclerotic across the strongly-pigmented choroid.

The yellowish, irregularly-shaped line which is represented near the margin of the optic disc to the left is the result of atrophy of the choroid at that spot.

The bluish-violet choroid is subtended by the white sclerotic, and is covered by the transparent retina.

Fig. 3.

The same parts as represented in fig. 1, from a person, aged 20, with brown irides.

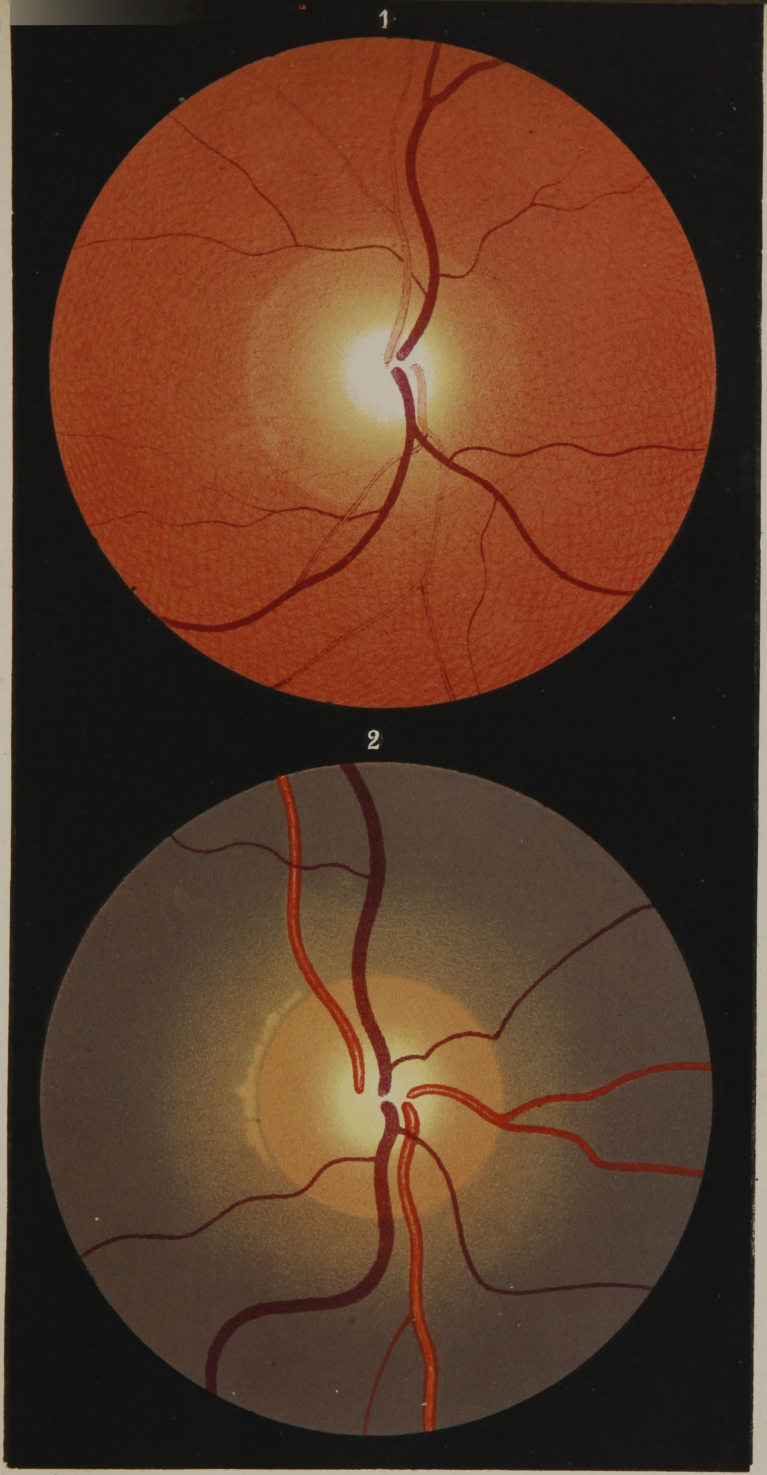
The optic disc (in the middle of the figure) appears slightly oval-shaped. Its centre is brilliant white, which colour shades off into the pale red colour of the rest of the optic disc.

The blood-vessels of the retina (three arteries and three veins) diverge from the white portion of the optic disc.

Along the margin of the optic disc towards the left we observe a white crescentic-shaped figure. This is part of the margin of the sclerotic aperture. The choroid covering it is transparent, instead of being vascular and pigmented. The red surface (sprinkled with irregularly-shaped brownish spots) which occupies the rest of the figure, represents the choroid, which is covered by transparent retina and subtended by the white sclerotic. The greater quantity of pigment in the choroid gives it a more brownish-red tint, as compared with the choroid represented in fig. 1.

FIGS. 4, 5, 6.

These figures represent, as regards size, shape, colour, &c., the optic discs as they appeared when examined with the ophthalmoscope by the indirect method. Figs. 1, 2, 3 are greatly enlarged views: Fig. 1, of fig. 4; fig. 2, of fig. 5; fig. 3, of fig. 6.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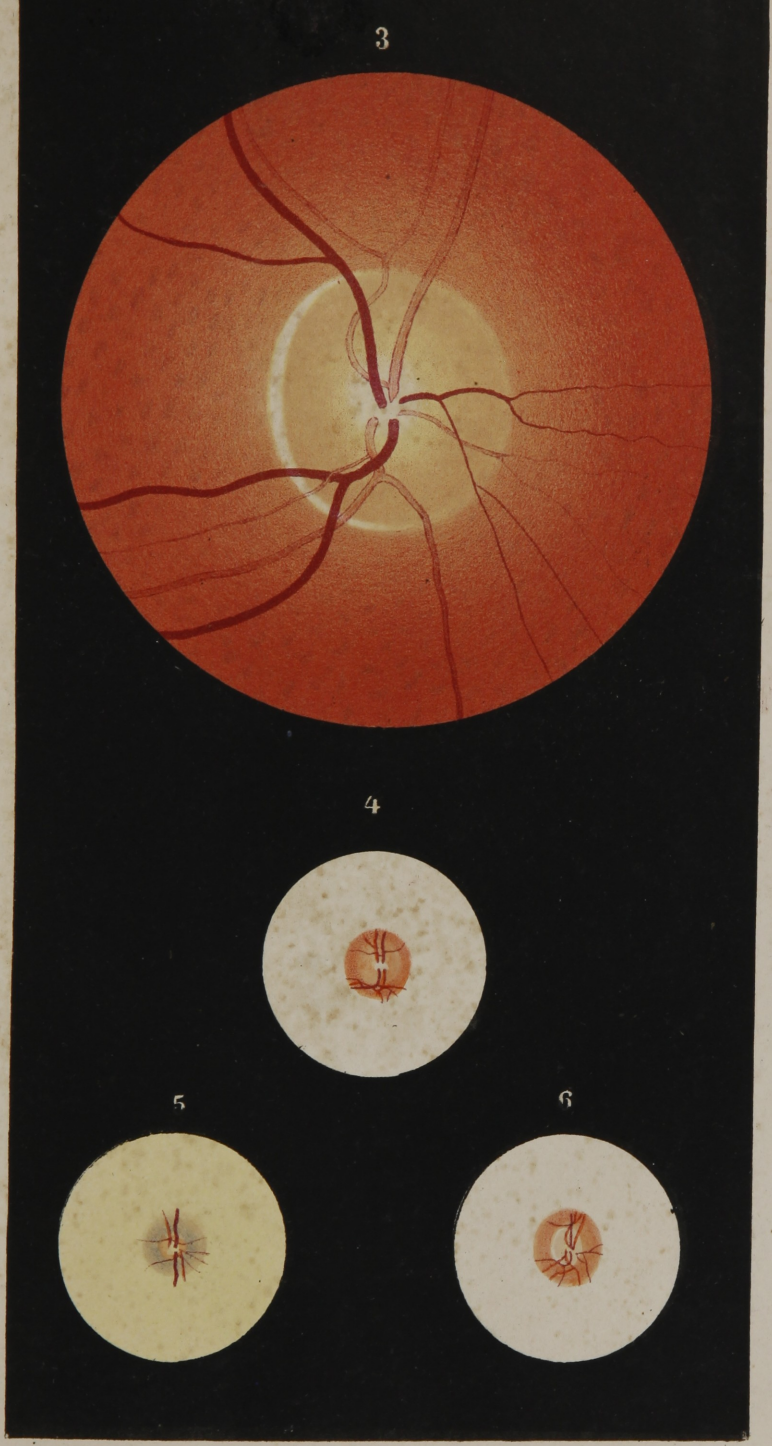
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